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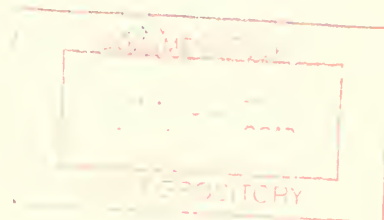
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**COMPARATIVE STRENGTH PROPERTIES OF  
WOODS FOR CROSSTIES**

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Senior Engineer

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# COMPARATIVE STRENGTH PROPERTIES OF WOODS FOR CROSSTIES<sup>1</sup>

By

L. J. MARKWARDT  
Senior Engineer

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The numerous species of wood found in the United States embrace a wide range of properties. With very few exceptions practically every commercial species is of some value for crossties, but the wide range in properties greatly affects their relative value.

Among the properties of importance in crossties are strength and decay resistance. Some woods are naturally decay-resistant, which is obviously a decided advantage, but deficiency in this respect can be overcome by preservative treatment. The fact that durability is controllable within certain limits makes the strength properties of chief importance. It is the purpose of this article to present data on the comparative strength properties of woods from the standpoint of their use as crossties.

The Forest Products Laboratory in its studies of wood, has made standard mechanical tests on small clear specimens of 164 of our native species. Winslow and Newlin<sup>2</sup> in 1916 presented a method of classifying the data on different mechanical properties from this study to obtain a single tie strength figure for each species, which represents an index of its suitability for ties, insofar as suitability from the strength standpoint can be expressed by a single figure. Three factors were considered of special importance in appraising the mechanical suitability of wood for crossties: (1) Its bending strength or ability to resist center or end binding; (2) its end hardness and strength in compression parallel to grain, which are indicative of its resistance to spike pulling, and the lateral thrust of spikes; and (3) its side hardness and compression perpendicular to grain, which indicate the ability to resist rail or plate wear. Data on all these properties are reflected in the "composite tie strength figure" arrived at.

The table presents composite tie strength figures for a large number of our native species and in addition give average values for specific gravity, compression perpendicular to grain, and side hardness.

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<sup>1</sup>Published in Railway Engineering & Maintenance, January 1931.

<sup>2</sup>See paper entitled "Discussion on Woods Suitable for Crossties," by C. F. Winslow and J. A. Newlin in the Proceedings of the American Wood-Preservers' Association, 1916, pages 238-247.



In the table, the species are listed alphabetically. The composite tie figures reflect the values on both green and dry material, and are calculated from comprehensive data recently presented in U. S. Department of Agriculture Technical Bulletin 158, "Comparative Strength Properties of Woods Grown in the United States." The values for compression perpendicular to grain and side hardness are for green material.

The data presented in the table are averages. In this connection, the figures for the less important species, which are based on fewer tests, are more subject to change on additional testing than those for the more common species.

The part of the tree from which the ties are produced is sometimes important as affecting the strength properties. The data presented are representative of material from the lower log. In most species ties cut from the tops are lighter and softer than those from lower in the tree.

Although the serviceability of any wood for ties is dependent on its mechanical properties, some properties and combinations of properties are often brought into play on which no adequate data are available. Furthermore, the relative importance of the several mechanical properties involved changes with conditions of track installation and maintenance, and with service conditions. Consequently, it is evident that the values presented in the table do not necessarily give a final measure of the exact suitability of species for crossties, but should rather be regarded as indicative of their utility. Service records when available are of great value in appraising the relative behavior of woods under any given set of conditions, and sometimes show that species with a fairly low composite tie strength figure may surpass one of higher rating.

Studies have shown that there is a relation between specific gravity and the various strength properties of wood, the densest material having the highest strength. This relationship holds in general among the different species, as may be observed from an examination of the data in the table, and also between individual pieces of the same species. Hence, the specific gravity gives a good indication of the ability of wood to resist the mechanical wear and to meet the other strength requirements of crossties. In the absence of actual tests, specific gravity determinations are recommended as a ready easy method of roughly determining the relative strength values of any given species.



... tests of small clear specimens.

Mechanical properties of woods used for cross-bow

Common name	Species	Practical name	Compressive strength	Specific gravity	Compression ratio	Size of cross-section	Weight	Length	Remarks
			lb. per sq. in.	lb. per cu. ft.	lb. per sq. in.	in. x in.	lb.	ft.	
Alder, red	<i>Alnus rubra</i> var.		432	0.37	310	160	160	160	160
Alder, white	<i>Alnus incana</i>		498	0.41	380	180	180	180	180
Aspen, white	<i>Picea canadensis</i>		487	0.35	340	170	170	170	170
Balsam poplar	<i>Populus balsamifera</i>		437	0.33	310	160	160	160	160
Basswood	<i>Liriodendron tulipifera</i>		400	0.30	280	140	140	140	140
Beech, black	<i>Fagus nigra</i>		510	0.40	390	190	190	190	190
Beech, white	<i>Fagus sylvatica</i>		510	0.40	390	190	190	190	190
Birch, black	<i>Betula nigra</i>		400	0.30	280	140	140	140	140
Birch, white	<i>Betula papyrifera</i>		400	0.30	280	140	140	140	140
Birch, yellow	<i>Betula pendula</i>		400	0.30	280	140	140	140	140
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Based on volume & use, need and weight were given 17%.



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